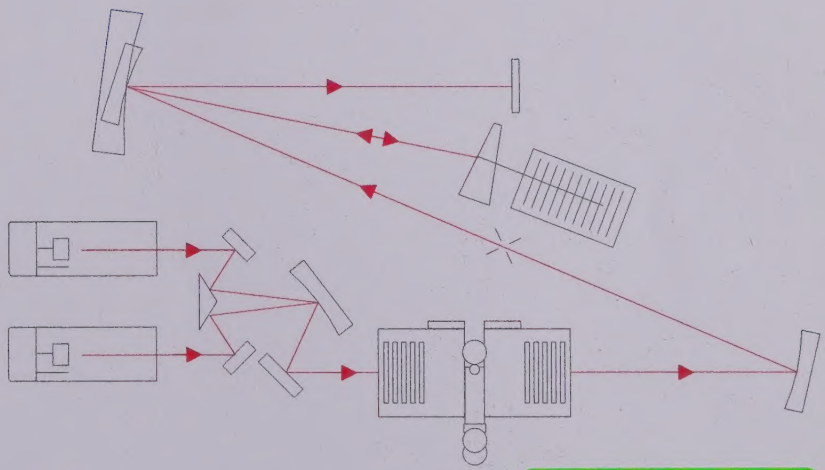
Atomic Spectrometry

SIMAA 6000

Simultaneous Multi-element Atomic Absorption Spectrometer

Installation Guide



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PERKIN ELMER

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SIMAA 6000

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Atomic Absorption Spectrometer

Installation Guide

PERKIN ELMER

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Other guides supplied with SIMAA 6000

In addition to this guide, there are a number of other guides supplied with your SIMAA 6000 analysis system.

Maintenance

This gives checklists of maintenance procedures and detailed descriptions of the maintenance you can do yourself on the spectrometer.

System Description

Describes how the SIMAA 6000 analysis system works and gives technical data about the system. It also includes translations of the warnings used in the SIMAA 6000 user's guides.

Setting Up and Performing Analyses

It describes in detail how to set up the system to perform multi-element analyses with the graphite furnace. It also gives a summary of the steps you need to perform the analysis — detailed procedures are in the online help, see below.

Online help

This is integrated into the AA WinLab software that controls the system. It is a context-sensitive help system that describes the commands and controls and contains detailed procedures for performing analyses. Since you use the AA WinLab software to start and control the analyses, and since the online help is context-sensitive, the information you need is always available at your fingertips while you are using the system.

THGA Recommended Conditions and Techniques

This gives advice on instrument settings and analytical procedures and techniques for use with the THGA graphite furnace.

Safety Information

1

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Introduction

The user's guides provided with your analytical instrument contain information and warnings that you must follow to ensure safe operation and to maintain the instrument in a safe condition. This advice is intended to supplement, not supersede, the normal safety code of behavior prevailing in the country of operation.

This chapter describes general safety practices for atomic spectroscopy and potential hazards with various atomic absorption techniques.
The information provided does not cover every safety procedure that should be practiced. Ultimately, maintenance of a safe laboratory environment is the responsibility of the user and the user's organization.

Correct use of analytical instruments

Before you install or use your instrument, and in order to get the best results, you should be familiar with all of the instruments in the system and know how to operate them. You should also be aware of the safety procedures in force in your laboratory, especially those concerning atomic spectroscopy instruments. Read the user's guides supplied with the instruments before you start.

If you use the instrument in a manner not specified in the handbooks, or if you use it for a purpose other than that intended, you may damage the instrument, or compromise your own, or someone else's, safety.

Analytical instruments should only be operated by persons who are suitably qualified and have received adequate training.

W1.2

Warning: Unauthorized Adjustments and Servicing

Only a Perkin-Elmer service engineer or similarly trained and authorized person should be permitted to service the instrument.

- *Do not attempt to make adjustments, replacements, repairs, or modifications to this instrument except as described in the documentation supplied with the instrument.*

Magnetic field

Zeeman graphite furnace systems

The electromagnet generates a strong magnetic field inside the furnace during measurement cycles.
There is a weak, accessible, stray magnetic field around the graphite furnace. This stray magnetic field can affect heart pacemakers and metallic implants up to 0.6 meter from the furnace in all directions. This stray field can also affect other instruments, watches, and magnetic storage devices.

- Do not operate the furnace when persons wearing electronic heart pacemakers, or having other metallic implants, are present.
- Anyone wearing a heart pacemaker or having metallic implants should remain at least 0.6 meter away from the furnace – in any direction – while the furnace is operating.

High temperatures

Graphite furnace

The THGA graphite furnace can generate temperatures of up to 2600 °C.

- Do not touch any part of the graphite furnace until it has cooled to room temperature.
- Do not attempt to inject a sample into the graphite tube when the furnace is hot. You may be subjected to fumes from the sudden vaporization of the sample, and may damage the pipet.

Quartz tube atomizer cell

The quartz tube atomizer cell (QTA-cell) used for the hydride-generation technique can reach temperatures of up to 1000 °C.

- Do not touch any part of the heating mantle (electrically heated systems), or the cell holder (flame-heated systems), or the QTA-cell until they have cooled to room temperature.

UV radiation

You should be aware of the health hazard presented by UV radiation.

- When the instrument is on, do not remove any covers unless specifically instructed to do so in the user's guide since otherwise you may be exposed to potentially hazardous UV radiation.
- Always wear UV-absorbing eye protection when viewing any of these sources:
  - The graphite furnace when it is heated to incandescence.
  - Hollow cathode or electrodeless discharge lamps.

Operating conditions

W1.3

Warning: Explosive Atmosphere

This instrument is not designed for operation in an explosive atmosphere.

The instrument will operate correctly under the following conditions:

- Indoors
- Ambient temperature +15 °C to +35 °C (+59 °F to +95 °F).
- Ambient relative humidity 20% to 80%, without condensation.
- Altitude in the range 0 m to 2000 m

You can store the instrument safely under the following conditions:

- Indoors
- Ambient temperature –20 °C to +60 °C (–4 °F to +140 °F)
- Ambient relative humidity 20% to 80%, without condensation.
- Altitude in the range 0 m to 2000 m.

  When you remove the instrument from storage, before you put it into operation allow it to stand for at least a day under the approved operating conditions.

Safety conventions in the User's Guides

Possible hazards that could harm the user or result in damage to the instrument are clearly stated at appropriate places throughout the user's guides.

Any of the following safety conventions can be used throughout these user's guides:

*This symbol alerts you to situations that could result in **personal injury** to yourself or other persons.*
Details about these circumstances are in a box like this one.

*This symbol alerts you to the risk of **electric shock** that could result in **personal injury** to yourself or other persons.*
Details about these circumstances are in a box like this one.

*This symbol alerts you to the risk of **hot surfaces** that could cause **personal injury** to yourself or other persons.*
Details about these circumstances are in a box like this one.

*This symbol alerts you to the risk of **ultraviolet radiation** that could cause **eye damage** to yourself or other persons.*
Details about these circumstances are in a box like this one.

Caution:
*The term CAUTION alerts you to situations that could result in **serious damage to the instrument** or other equipment.*
Details about these circumstances are described in a message similar to this one.

General safety practices

Laboratory hygiene

- Keep the work area scrupulously clean to avoid contaminating your samples and to maintain a safe working environment. Clean up spilled chemicals immediately and dispose of them properly.
- Do not allow smoking in the work area. Smoking is a source of significant contamination and also a potential route for ingesting harmful chemicals.
- Do not store, handle, or consume food in the work area.

Laboratory ventilation

Toxic combustion products, metal vapor, ozone, etc., can be generated by the system, depending on the type of analyses being performed.

- You must provide an efficient laboratory ventilation system to remove toxic products generated during instrument operation.

Electrical safety

Two versions of the SIMAA 6000 spectrometer are available, a 240 V, 60 Hz version, and a 3~230 V, 50 Hz version. Each versions is fitted with a special connector suitable for the intended power supply. The spectrometer must be installed by a Perkin-Elmer service engineer.

W2.1

Warning: Electrical Hazard

Any interruption of the protective conductor inside or outside the instrument or disconnection of the protective conductor (earth/ground) terminal is likely to make the instrument dangerous.
Intentional interruption is prohibited.

Lethal voltages are present in the instrument

- *Even with the power switch off, line power voltages can still be present within the instrument.*
- *When the instrument is connected to line power, terminals may be live, and opening covers or removing parts (except those to which access can be gained without use of a tool) is likely to expose live parts.*
- *Capacitors inside the instrument may still be charged even if the instrument has been disconnected from all voltage sources.*

When working with the instrument:

- Connect the instrument to a correctly installed line power outlet that has a protective conductor (earth/ground).
- Do not attempt to make internal adjustments or replacements except as directed in the handbooks provided with the instrument.
- Do not operate the instrument with any covers or parts removed.
- Disconnect the instrument from all voltage sources before opening it for any adjustment, replacement, maintenance, or repair.
  If, afterwards, the opened instrument must be operated for further adjustment, maintenance, or repair, this must only be done by a skilled person who is aware of the hazard involved.
- Use only fuses with the required current rating and of the specified type for replacement.
  Do not use makeshift fuses or short-circuit the fuse holders.
- Whenever it is likely that the instrument is no longer electrically safe for use, make the instrument inoperative and secure it against any unauthorized or unintentional operation.

  The instrument is likely to be electrically unsafe when it:
  - Shows visible damage.
  - Fails to perform the intended measurement.
  - Has been subjected to prolonged storage under unfavorable conditions.
  - Has been subjected to severe transport stresses.

Waste disposal

Contents of waste containers

The materials that you collect in waste containers may include small amounts of the substances that were analyzed and other chemicals used in the analyses. If these materials are toxic, corrosive, or contain organics you may have to treat the collected effluent as hazardous waste. Refer to your local safety regulations for proper disposal procedures.

Disposing of defective lamps

Hollow cathode lamps and electrodeless discharge lamps contain small quantities of the lamp element in a very pure form. If a lamp containing toxic elements becomes defective or otherwise unusable, you must treat it as hazardous waste and dispose of it accordingly. A licensed company in the chemical waste disposal business can provide lamp disposal in accordance with environmental regulatory requirements. Please note that Perkin-Elmer does not take back defective lamps for disposal.
In addition, hollow cathode lamps and deuterium lamps are maintained under reduced pressure. Handle and dispose of them correctly to minimize the implosion risk.

For information, the quantities of analyte material contained in the cathodes of hollow cathode lamps are listed in the table below:

Quantity of material in the cathode	*Single-element hollow cathode lamps*	*Multi-element hollow cathode lamps*
less than 5 g	As, Au, B, Ba, Be, Ca, Dy, Er, Eu, Ga, Gd, Ge, Hf, Ho, In, Ir, K, La, Li, Mg, Na, Nd, Pd, Pr, Pt. Re, Rh, Ru, Sc, Se, Sm, Sn, Ta, Tb, Tm, Yb, Y	Na-K, Pt-Ru
5–10 g	Ag, Al, Bi, Cd, Co, Cr, Mn, Mo, Ni, Sb, Si, Sr, Te, V, W, Zn, Zr	Ca-Mg, Ca-Zn, Ag-Au, Sn-Te, Ca-Mg-Zn, Ca-Mg-Al
10–15 g	Cu, Fe, Hg, Nb, P, Pb, Ti, Tl	all other multi-element HCLs

For EDLs, the quantity of analyte material used is much less than the quantities used in HCLs. Typically, only several milligrams of material are placed in the EDL bulb. No Perkin-Elmer EDLs (System 1 or 2) contain more than 0.05 g of analyte material.

Safe handling of chemicals

Some chemicals used with the instrument may be hazardous or may become hazardous after completion of an analysis.

The responsible body[1] must take the necessary precautions to ensure that the surrounding workplace is safe and that instrument operators are not exposed to hazardous levels of toxic substances (chemical or biological) as defined in the applicable national, state, and local health and safety regulations and laws. Venting for fumes and disposal of wastes must be in accordance with all national, state, and local health and safety regulations and laws.

- Use, store, and dispose of chemicals in accordance with the manufacturer's recommendations and the applicable national, state, and/or local regulations.
- Wear appropriate eye protection at all times while handling chemicals. Depending on the types of chemicals you are handling, wear safety glasses with side shields, or goggles, or a full-face shield.
- Wear suitable protective clothing, including gloves if necessary, resistant to the chemicals you are handling.
- When preparing chemical solutions, always work in a fume hood that is suitable for the chemicals you are using.
- Perform sample preparation away from the instrument to minimize corrosion and contamination.
- Clean up spills immediately using the appropriate equipment and supplies, such as spill cleanup kits.
- Do not put open containers of solvent near the instrument.
- Store solvents in an approved cabinet (with the appropriate ventilation) away from the instrument.

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1. Definitions from IEC 1010-1:
   Responsible body: 'individual or group responsible for the use and maintenance of equipment, and for ensuring that operators are adequately trained.'
   Operator: 'person operating equipment for its intended purpose.'

Handling compressed gases

Note: The permanent installation of gas supplies is the responsibility of the user and should conform to local safety and building regulations.

Summary of gas hazards

Hazards associated with the different gases used in atomic absorption spectrometry are presented in the table below:

Gas	Suffocation	Explosion	Spontaneous Decomposition or Combustion
Air	–	–	–
Argon	x	–	–
Nitrogen	x	–	–
Acetylene (ethyne, C_2H_2)	x	x	x
Nitrous Oxide (dinitrogen monoxide, N_2O)	x	–	x

Contact the gas supplier for a safety data sheet containing detailed information on the potential hazards associated with the gas.

Identifying cylinders

- Legibly mark cylinders to clearly identify the contents and status (full, empty, etc.). Use the chemical name or commercially accepted name for the gas.

Handling cylinders

- Move cylinders with a suitable hand truck after making sure that the valve cap is securely in place and that the cylinder is properly fastened to the hand truck.
- Use only approved regulators, tubing, and hose connectors. When you connect fittings, keep in mind that left-hand thread fittings are used for fuel gas connections (e.g., acetylene), whereas right-hand thread fittings are used for oxidant and support gas connections (e.g., nitrous oxide, air).
- Arrange gas hoses where they will not be damaged or stepped on and where things will not be dropped on them.
- Do not 'crack the valve' or open the valve of an acetylene cylinder before attaching a regulator.

- Do not attempt to refill gas cylinders.
- Check the condition of pipes, hoses, and connectors regularly, and replace any damaged parts.
- Perform periodic gas leak tests at all joints and seals of the gas system by applying an approved gas leak detection solution.

Storing cylinders

- Store cylinders in accordance with the applicable national, state, and/or local regulations and standards.
- When gas cylinders are stored in confined areas, such as a storage room, make sure that ventilation is adequate to prevent toxic or explosive accumulations of gas.
  The storage room should be well ventilated and dry. This is particularly important in confined areas.
- Do not store cylinders near elevators, gangways, or in locations where heavy moving objects may strike or fall against them.
- Use and store cylinders away from exits and exit routes.
- Locate gas cylinders away from heat sources, including heat lamps. Compressed gas cylinders should not be subjected to temperatures above 52 °C (125 °F).
- Do not allow ignition sources in the storage area and keep cylinders away from readily ignitable substances such as gasoline or waste, or combustibles in bulk, including oil.
- Store all gas cylinders only in a vertical position, with the valve cap in place, and fastened securely to an immovable bulkhead or a permanent wall.
- If you are storing cylinders outdoors, store them above ground on a suitable floor where they are protected against temperature extremes (including the direct rays of the sun).

References for laboratory safety practice

- Bretherik, L., *Bretherik's Handbook of Reactive Chemical Hazards*, 4th ed., Butterworth & Co. Ltd., London, UK, 1990.
- Bretherik, L., *Hazards in the Chemical Laboratory*, 3rd ed., Royal Society of Chemistry, London, UK, 1981.
- *CRC Handbook of Laboratory Safety*, 3rd ed., Furr, K., ed., The Chemical Rubber Co. Press, Florida, USA, 1990.
- *Prudent Practices for Handling Hazardous Chemicals in Laboratories*, National Research Council, National Academic Press, Washington D.C., USA, 1981.
- Sax, N., ed., *Dangerous Properties of Industrial Materials*, 7th ed., Van Nostrand Reinhold, New York, 1989.
- Compressed Gas Association, Inc., Arlington, VA 22202, USA, various publications.
- Data Sheets provided by chemical manufacturers, e.g.:
  – USA, Material Safety Data Sheets (MSDS),
  – FRG, DIN-Sicherheitsblätter,
  – UK, Hazard Data Sheets.

Symbols used on the instrument

Any of the following symbols can be used on the instrument:

This symbol indicates that there is a potential hazard and that the user must look in the handbook for an explanation of the hazard and how to avoid it.

This symbol indicates the risk of electric shock.

This symbol indicates the risk of hot surfaces.

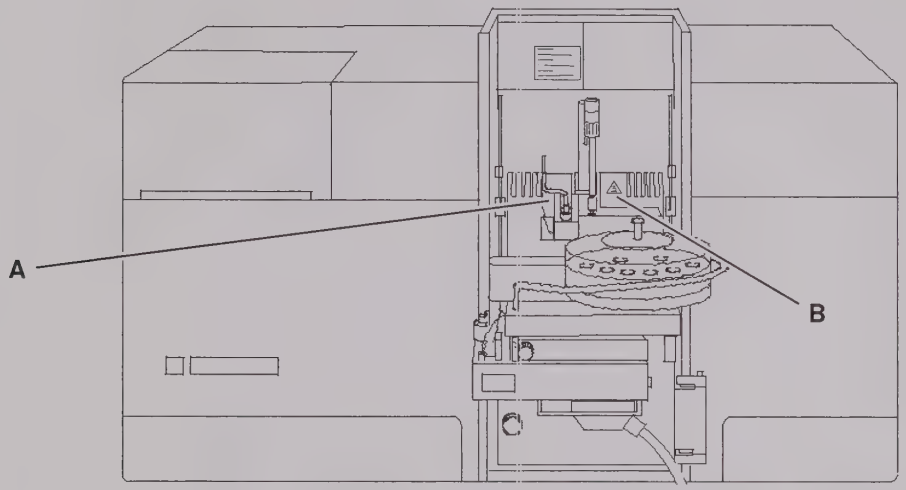
This symbol indicates the off position of the main power switch or circuit breaker. With the switch in this position, the instrument is disconnected entirely from the line power supply.

This symbol indicates the on position of the main power switch or circuit breaker. With the switch in this position, the instrument is connected to the line power supply but is not necessarily switched on and operational.

This symbol indicates the operational on/off switch.
This switch turns the instrument on and off, but it does not disconnect the instrument from the line power supply.

This symbol indicates alternating current.

Warning markings on the front of the instrument



A

Strong Magnetic Field
Anyone wearing a heart pacemaker or having metallic implants should remain at least 0.6 meter away from the furnace – in any direction – while the furnace is operating.

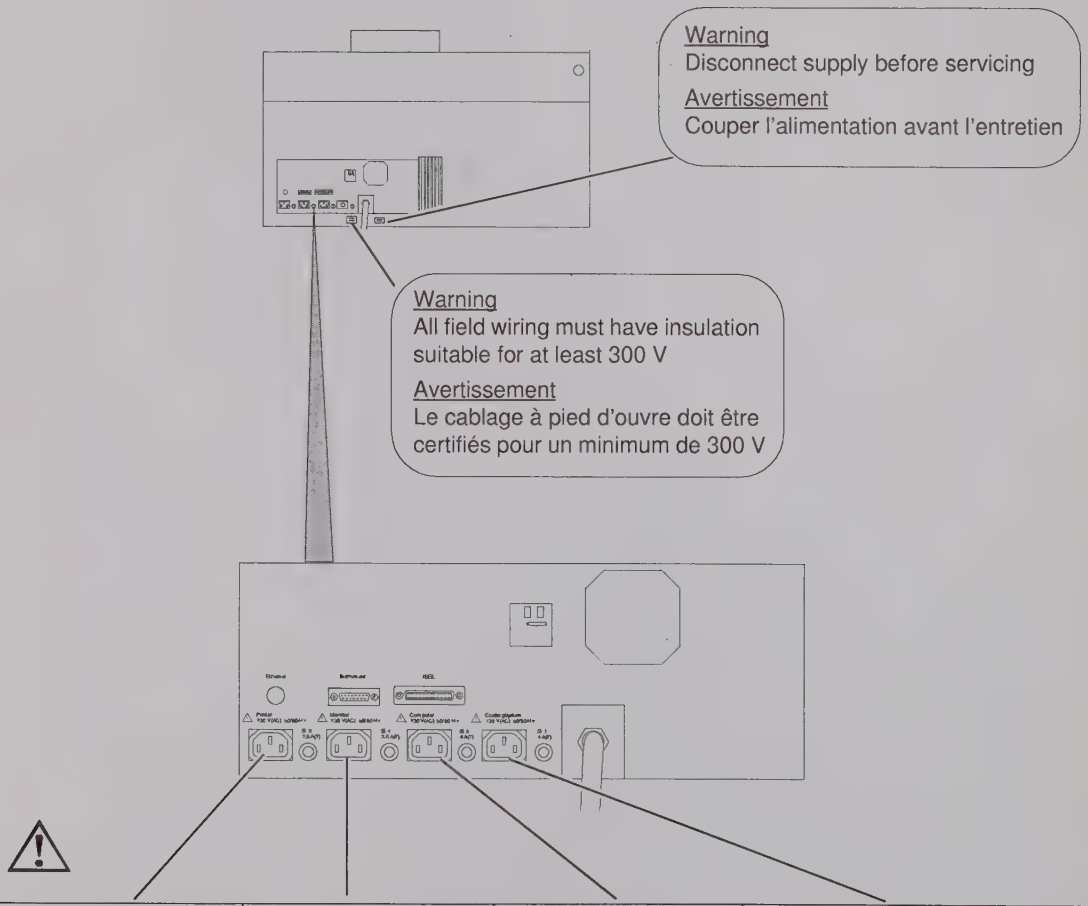
Champ magnétique intense
Tout personne ayant un stimulateur cardiaque ou des implants métalliques doit rester éloignée d'au moins 0,6 m du four pendant le fonctionnement de celui-ci.

Starkes Magnetfeld
Herzschrittmacherträger und Personen mit Metall-Implanten müssen zum Magneten einen Sicherheitsabstand von mindestens 0,6 m in jeder Richtung um den Magneten einhalten.

B

Risk of hot surfaces
Risque de surfaces chaudes
Gefahr durch heiße Oberflächen

Warning markings on the rear of the instrument


Warning
Disconnect supply before servicing
Avertissement
Couper l'alimentation avant l'entretien
Warning
All field wiring must have insulation suitable for at least 300 V
Avertissement
Le cablage à pied d'ouvre doit être certifiés pour un minimum de 300 V

Printer Imprimante 230 V(AC) 50/60 Hz	Monitor Ecran 230 V(AC) 50/60 Hz	Computer Ordinateur 230 V(AC) 50/60 Hz	Cooling System Système de Refroidissement 230 V(AC) 50/60 Hz
The power outlets shown above provide 230 V (AC) at 50 or 60 Hz in both 240 V and 3~230 V instruments. Only connect ancillary equipment to these sockets if the equipment requires 230 V at 50/60 Hz.			*Only connect the Cooling System to this socket. This is an automatically switched socket controlled by the spectrometer.*

Installing SIMAA 6000

2

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Before you install the spectrometer

When the spectrometer arrives

- Check the exterior of the shipping crate for obvious signs of damage. If the crate has been damaged, file a claim with the authorized carrier immediately and inform your nearest Perkin-Elmer office.
- Contact your local Perkin-Elmer office to arrange for the installation.

Before the service engineer arrives

- You must prepare a suitable site for the spectrometer and any accessories. See *Laboratory Requirements*, and the guides for any accessories.
- You must make sure that the fume ventilation system and the necessary gas supply lines and regulators are installed.
- Although you should not perform the initial installation yourself, we recommend that you read the installation instructions to learn about the spectrometer and its requirements before you start using it.
  These instructions are also provided in case you need to alter any of the connections or move the instrument.

When the service engineer arrives

- The service engineer will remove the spectrometer from the crate and check that all parts have been delivered. If anything is missing or damaged, the service engineer will make sure that the respective parts are supplied.
- The service engineer will remove the shipping locks, perform pre-installation checks, install the spectrometer, and make sure that everything functions correctly.

Moving and reinstalling the spectrometer

We recommend that only a Perkin-Elmer service engineer or a Perkin-Elmer trained and authorized person moves and reinstalls the spectrometer.
Should you attempt to do this yourself, Perkin-Elmer cannot be held responsible for any damage or malfunctioning of the spectrometer.
The instructions here are primarily intended for occasions where you may want to move the spectrometer **short** distances to a new location within the laboratory.
Read the instructions carefully and be sure you understand them thoroughly before you attempt to move the spectrometer. Read the detailed information given in the relevant sections of this chapter before you reinstall the spectrometer.
If you intend to transport the spectrometer over a longer distance, contact your local Perkin-Elmer office since some shipping locks must be set via the service software, inside the spectrometer.

Preparing the spectrometer to be moved

1. Close the AA WinLab application, then shut down the Windows operating system.
2. Switch off the spectrometer, computer and all the accessories.
3. Disconnect all the electrical cables.
4. Remove the furnace autosampler from the spectrometer; (*procedure: page 2-14*).
5. Disconnect the furnace gas supplies.
6. Prepare the computer and other system components for transport as described in their own guides.
7. Attach the original handles securely. Only use the original handles and screws.

Make sure that the handles are properly secure before you move the spectrometer.

Moving the spectrometer

W1.4

Warning: Risk of injury through lifting

The instrument weighs approximately 200 kg.

Improper lifting can cause painful and sometimes permanent back injury.

- *Use proper lifting techniques and always use the handles to lift or move the instrument.*

Caution: Risk of damage to the instrument

The spectrometer is a precision optical instrument. Move the spectrometer very carefully and protect it from vibrations and jolts. Do not tilt the spectrometer. If the spectrometer must be tilted or mechanically lifted, contact your Perkin-Elmer service representative before moving the spectrometer. The shipping locks must be properly secured to prevent any damage occurring if the spectrometer is tilted or jolted.

Carefully lift the spectrometer onto a movable table to transport it to the new location.

Reinstalling the spectrometer

Reinstall the spectrometer by following exactly the procedures described in this chapter, as summarized in the steps below.

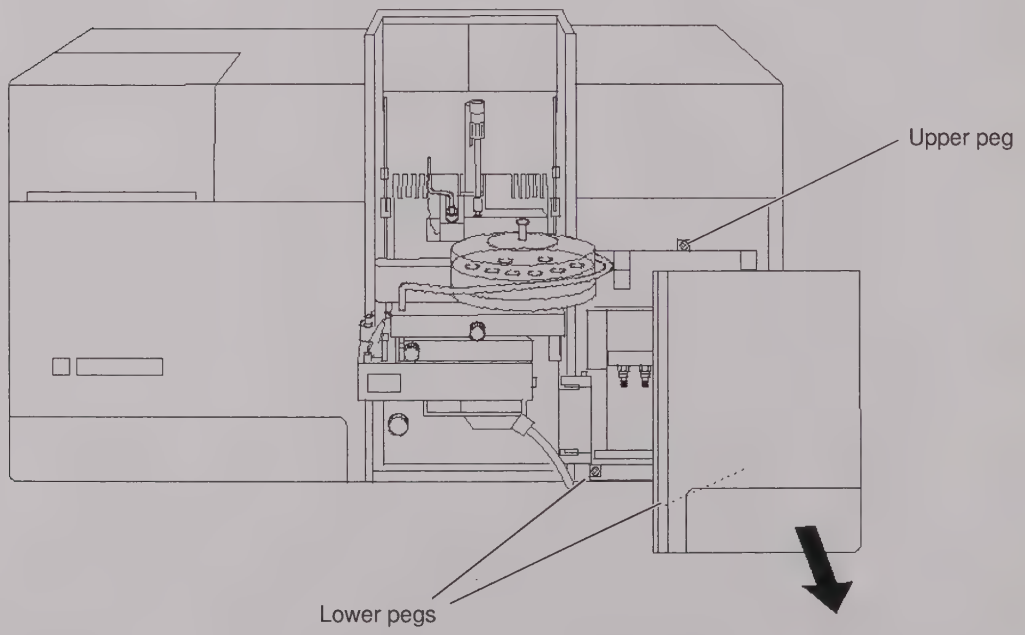
1. Prepare the new site for the spectrometer; see *Laboratory Requirements*.
2. Remove the handles. Save the handles and screws.
   Insert the plastic plugs provided (B015-3803) into the screw holes.
3. Connect the furnace gas supplies.
4. Install the furnace autosampler.
5. Connect the cooling system.
6. Make sure that the main power switches of all the instruments are in the off position, then connect the electrical cables.

Removing the front panel

The inlet manifolds for the furnace gases and cooling system are behind the panel at the front right-hand side of the spectrometer.

1. On the rear of the panel are three spring clips that engage pegs on the spectrometer.
2. Grip the lower edge of the panel and firmly but carefully pull the panel off the lower two pegs on the spectrometer. Then pull the panel off the upper peg.

To replace the panel, locate the spring clips over the pegs on the spectrometer, then push the panel firmly onto the pegs.



Connecting the furnace gases

The connectors for the furnace gases are located behind the front panel of the spectrometer.

Note: *The furnace will operate correctly only if there is gas pressure at both the Normal Gas and Special Gas inlets. If you are using only an inert gas you must connect the gas to both inlets using the Y-connector.*

What you need to provide:

- A suitable supply of argon (or nitrogen) and if necessary a suitable supply of a special gas. The gases must conform with the requirements listed in *Laboratory Requirements*.
- Suitable pressure regulators and on/off valves near to the spectrometer for the inert and special gas supplies.
- A tube cutter for the special gas tube. This is an optional accessory; Part No. 0992-3183.

The gas supply systems must comply with your local safety regulations. Refer also to the information given under *Safety Information*.

What is provided with the spectrometer:

- About 10 m of special gas tube, B050-8264.
- A Y-connector with automatic push-fit connectors, 0992-0179.
- Two screw connectors, R ¼" for the gas regulator. These are not supplied with all instrument versions.

Connecting the gases

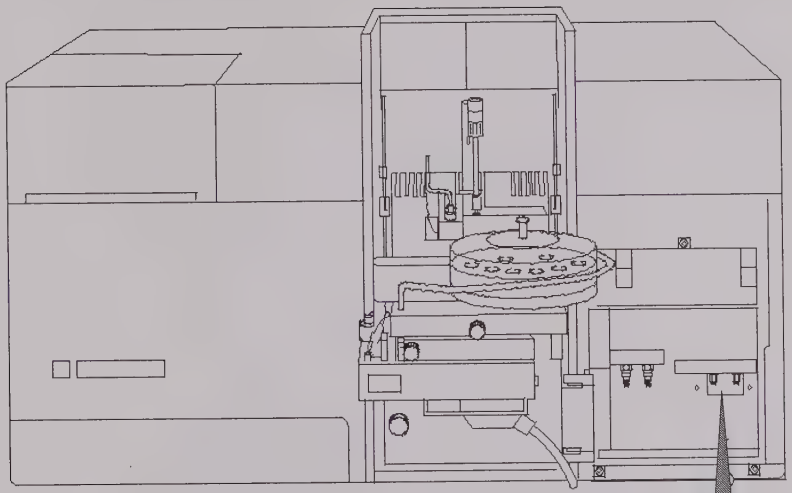
1. Remove the front panel of the spectrometer; (*procedure: page 2-6*).
2. Make sure that the argon (or nitrogen) supply is turned off.
3. **To connect argon (or nitrogen) only**
   1. Use the special tube cutter to cut two, 10 cm lengths of tube from the special gas tube. The ends of the tubes must be cut squarely.
   2. Connect the long gas tube to the argon (or nitrogen) pressure regulator. Use the R ¼" screw connector provided or use a connector or adapter suitable for the gas regulator. Make sure that all the connections are secure.
   3. Pass the gas tube to the front of the spectrometer. Make sure that it cannot be damaged or strained.
   4. Push the two short tubes and the long tube into the connectors on the Y-connector as shown in the illustration.
   5. Push the free ends of the two short gas tubes into the **Normal Gas** and **Special Gas** connectors on the manifold as shown.
      Push the tubes into the connectors until the tubes butt up to the end of the connector.

— or —

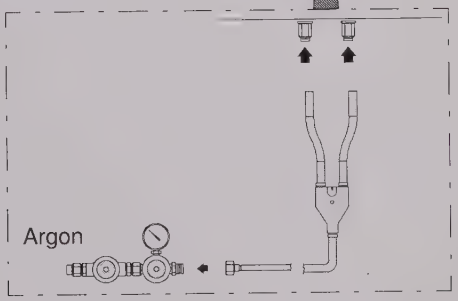
To connect both argon and a special gas

1. Use the special tube cutter to cut the special gas tube into two pieces for the two gas supplies. The ends of the tubes must be cut squarely.
2. Connect the gas tubes to the argon (or nitrogen) and special gas pressure regulators. Use the R ¼" screw connectors provided or use a connector or adapter suitable for the gas regulator. Make sure that all the connections are secure.
3. Pass the gas tubes to the front of the spectrometer. Make sure that they cannot be damaged or strained.
4. Push the free ends of the gas supply tubes into the **Normal Gas** and **Special Gas** connectors on the manifold as shown.
   Push the tubes into the connectors until the tubes butt up to the end of the connector.

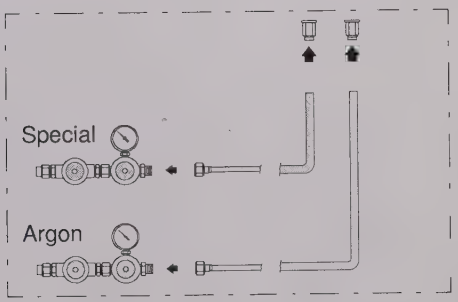
Note: *To disconnect the gas tube from a connector:*
Carefully push the black locking ring of the connector into the connector and pull the tube out of the connector.



Connecting normal gas only



Connecting normal and special gas



Installing the cooling system

A recirculating cooling system is provided with the spectrometer system. This system includes a pressure-sensitive safety switch that switches off the pump if the internal pressure in the circulatory system increases to above a safe value.

Caution: Risk of damage to the instrument from high water pressure

High water pressure may cause the coolant tubes on the furnace to burst. The cooling system includes a pressure-sensitive safety switch that switches off the pump if the pressure becomes too high for any reason. The pressure in the main laboratory water supply may be too high for safety.

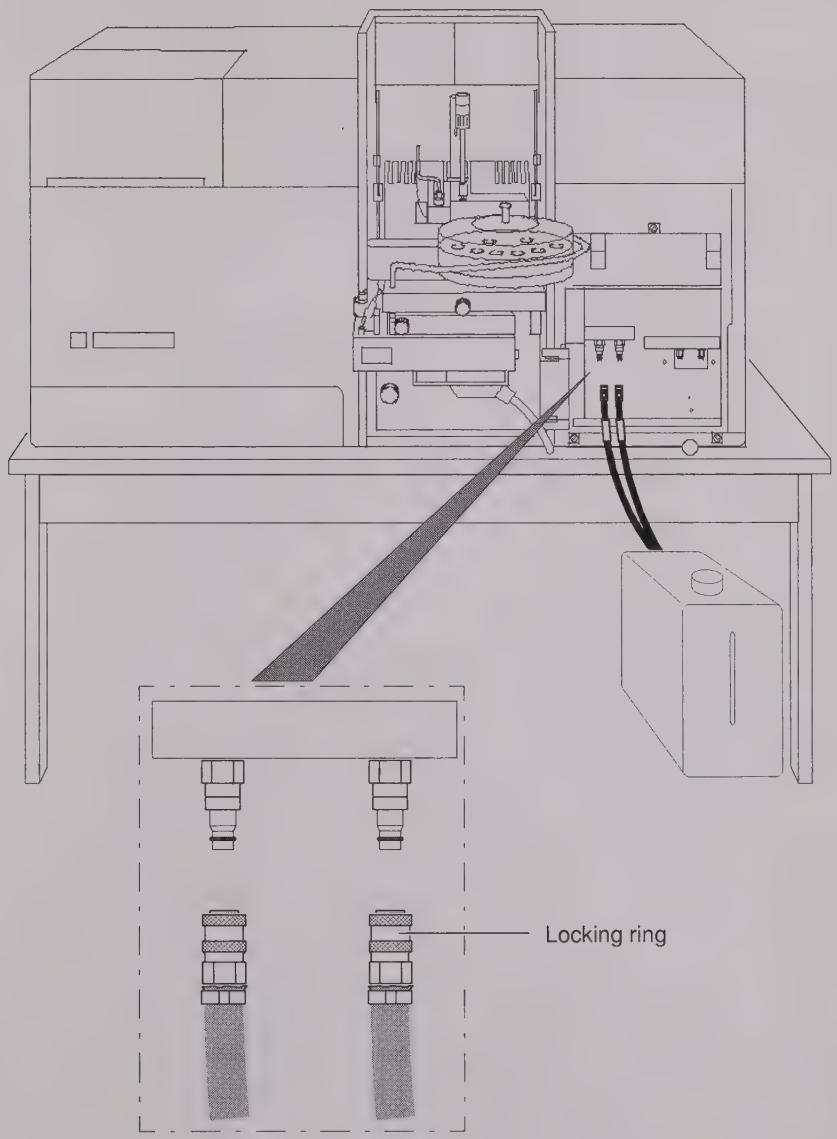
- *Never connect the spectrometer system directly to the main laboratory water supply. Always use the cooling system.*

Connecting and disconnecting the water hoses

The inlet and outlet hoses are permanently attached to the cooling system. They have automatic connectors which are marked with the direction of the water flow.

1. Remove the front panel of the spectrometer; (*procedure: page 2-6*).
2. Place the cooling system in a convenient position on the floor underneath the spectrometer. Make sure that:
   - You can reach the on/off switch at the rear.
   - There is space at the rear and sides of the cooling system for air to circulate freely.
   - There is space to remove the stopper and fill the system.
   - You can see the water level indicator.
3. Pass the two hoses from the cooling system to the front of the spectrometer. Make sure they are not strained.
4. Push the hose connectors onto the correct fittings on the spectrometer as shown opposite.
   The connectors are spring loaded. Push them straight onto the fittings until they click into place.

   Note: *To disconnect the water hoses:*
   Carefully pull the knurled locking ring down slightly, to release the lock, and pull the connector off the fitting on the spectrometer.


Locking ring

Installing the fume extraction unit

A Perkin-Elmer service engineer will install the fume extraction unit when he or she installs the spectrometer.

You must use the fume extraction unit in conjunction with the main fume ventilation system since the extraction unit is not always operating when the furnace is operating. Make sure that the main fume ventilation system removes the fumes from the graphite tube efficiently so that the fumes do not accumulate in the work area.

When the fume extraction unit has been installed, you have to remove and reinstall the components only to perform maintenance on the fume extraction unit or on the furnace.

Before you use the furnace, make sure that the fume extraction unit is set up correctly as described in the guide: *Setting Up and Performing Analyses*.

Installing the furnace autosampler

The first installation

A Perkin-Elmer service engineer will install the autosampler when he or she installs the spectrometer. These instructions are provided for those occasions when you may need to remove and re-attach the autosampler.

Usually there is no need to remove the autosampler when working on the furnace. The furnace compartment door will open through 90° even with the autosampler attached.

The procedures for changing and cleaning parts are described in detail in the *Maintenance* guide.

Summary of the installation procedure

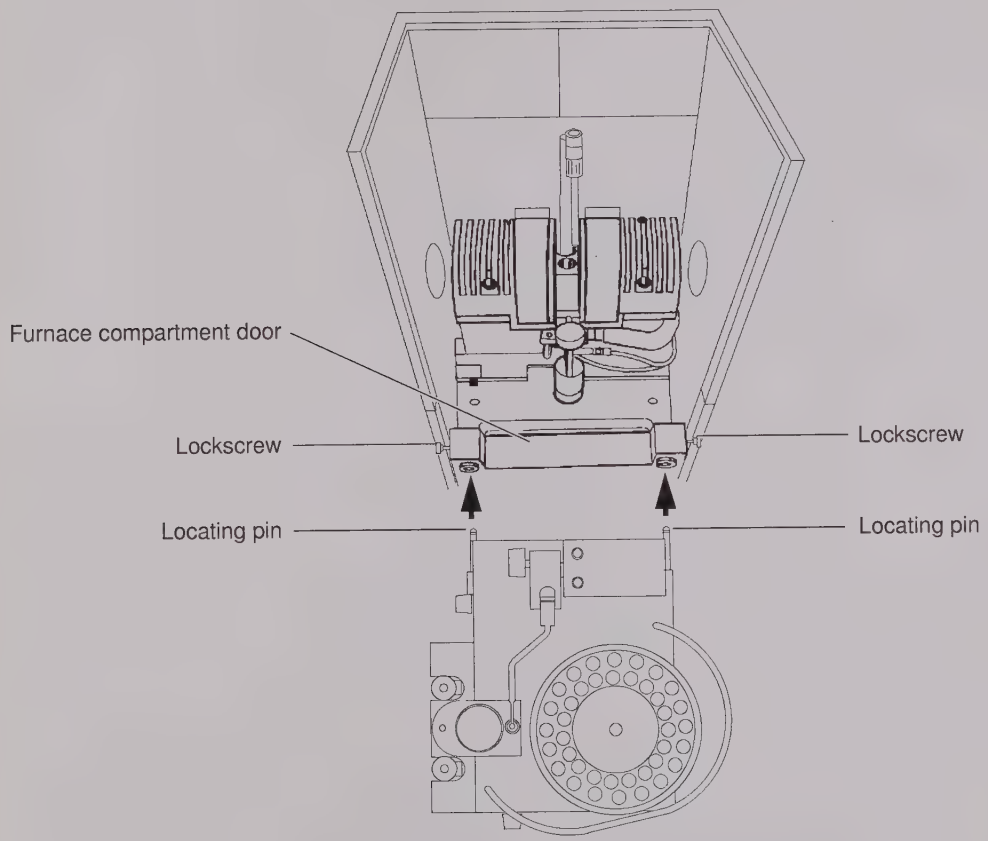
1. Attach the autosampler to the furnace compartment door; (*procedure: page 2-14*).
2. Connect the control cable; (*procedure: page 2-16*).
3. Connect the rinse supply and drain; (*procedure: page 2-17*).
4. Make sure that the pump heads are correctly aligned, with the moulded arrows on the pump heads pointing vertically upwards. The procedure is described in the *Maintenance* guide.
5. Install the sample trays and reagent containers, prime the rinsing system and align the sampler arm; see the guide: *Setting Up and Performing Analyses*.

Attaching the autosampler to the furnace

1. Make sure the spectrometer is switched off.
2. Make sure that the door of the furnace compartment is shut and secured with the large locking screw.
3. Unscrew the two small lockscrews on the left- and right-hand side of the top of the furnace compartment door. Make sure that the holes for the autosampler locating pins are free.
4. Hold the autosampler securely and guide the locating pins into the holes in the furnace compartment door. See the illustration opposite.
5. Tighten the two small lockscrews securely to clamp the locating pins.

Detaching the autosampler from the furnace

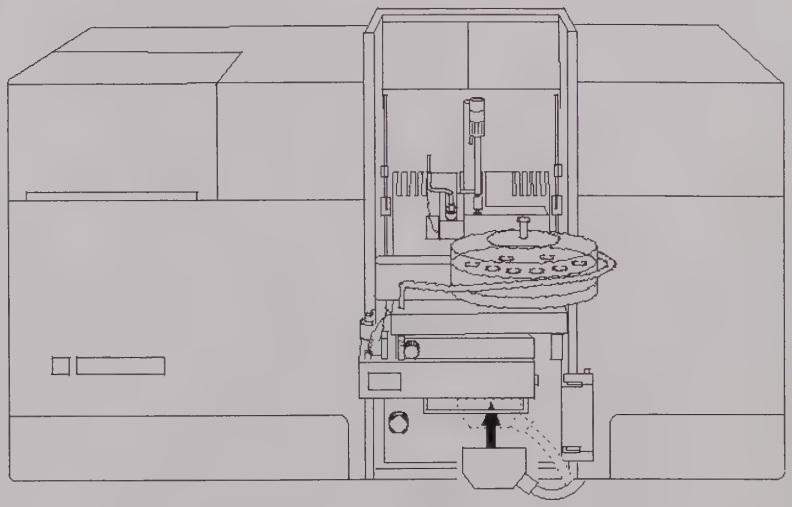
1. Make sure the spectrometer is switched off.
2. Make sure that the door of the furnace compartment is shut and secured with the large locking screw.
3. Disconnect the control cable; *illustration page 2-16*.
4. Unscrew the two small lockscrews on the left- and right-hand side of the top of the furnace compartment door.
5. Hold the autosampler securely and pull it away from the furnace compartment door. See the illustration opposite.
6. Place the autosampler upright, in a position where its components will not be damaged or strained.


Furnace compartment door
Lockscrew
Lockscrew
Locating pin
Locating pin

Connecting the autosampler cable

The connector of the control cable fits into the socket on the underside of the autosampler. The cable emerges from the right-hand side of the furnace compartment door.

1. Make sure the spectrometer is switched off.
2. Insert the connector into the socket on the underside of the autosampler. The connector is asymmetric, make sure that you orient it correctly. Do not use excessive force.
3. Slide the locking plate on the connector to the position that secures the connector.



Connecting the rinse supply and drain

The rinse and waste bottles supplied with the instrument are made from polyethylene (PE). Polytetrafluoroethylene (PTFE) bottles are available as an option. PE is resistant to most common rinsing solutions. If you are using an aggressive rinsing solution, use the PTFE bottles. You may have to change the drain tube more often if you are using an aggressive rinsing solution. The rinse feed tube is resistant to both acidic and organic rinsing solutions.

If you use the PTFE rinse bottle, you must also use the PTFE waste bottle and install the special bottle holder on the furnace compartment door. These parts are supplied as a kit; see the Perkin-Elmer supplies catalog.

Note: *After you have made any alterations to the rinsing system, prime the rinsing system and align the sampler arm; see the Setting Up and Performing Analyses guide.*

To install the drain tube and bottle

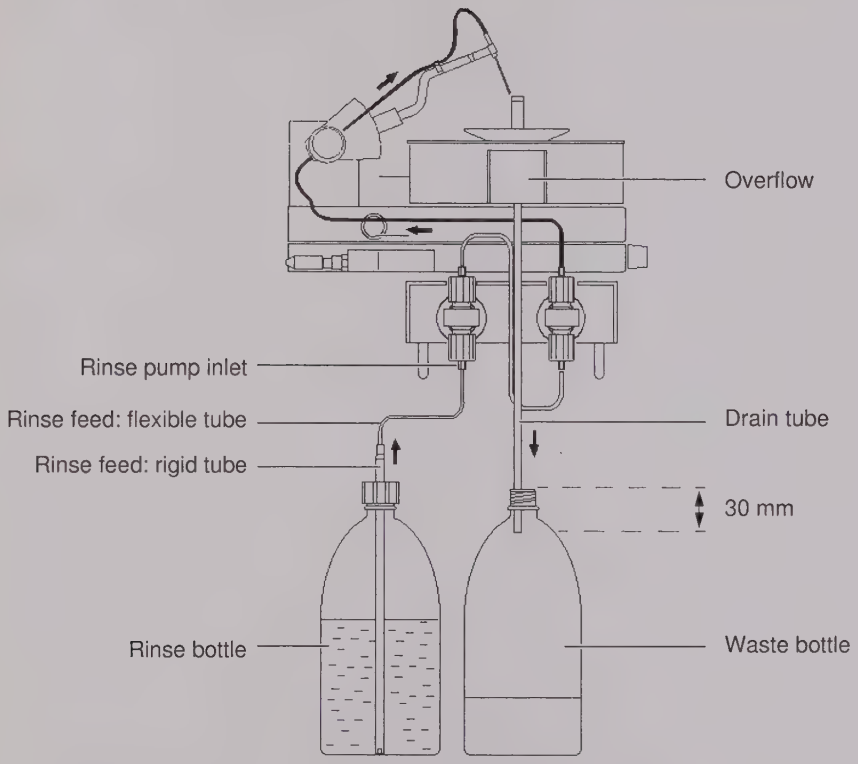
1. Push one end of drain tube onto the drain nipple on the underside of the overflow.
2. Place the waste bottle in the left-hand location of the bottle rack on the furnace compartment door. The liquid level in the bottle must be visible to the user of the instrument.
3. Place the end of drain tube into the mouth of the waste bottle. If necessary, shorten the drain tube so that it protrudes only about 30 mm into the waste bottle.
4. Do not put the cap on the bottle. Two tubes must enter the waste bottle, the drain tube and the fume vent tube from the fume extraction unit. Secure the drain tube so that it cannot accidentally come out of the bottle.

Note: *The waste tube must hang straight down, without any loops, and the lower end must never be immersed in the liquid in the bottle.*

To install the rinse feed tube and bottle

The rinse feed assembly, consists of a flexible, PTFE tube with two screw fittings and a rigid, FEP tube with a complimentary screw thread.

1. Push the notched end of the rigid tube through the bottle cap until the tube touches the base of the bottle.
2. Connect one end of the flexible tube to the rigid tube.
3. Connect the other end of the flexible tube to the inlet of the rinsing pump.
4. Place the rinse bottle in the right-hand location of the bottle rack on the furnace compartment door. The top of the bottle must be lower than the rinsing pump.


Overflow
Rinse pump inlet
Rinse feed: flexible tube
Rinse feed: rigid tube
Drain tube
30 mm
Rinse bottle
Waste bottle

Electrical connections

W2.3

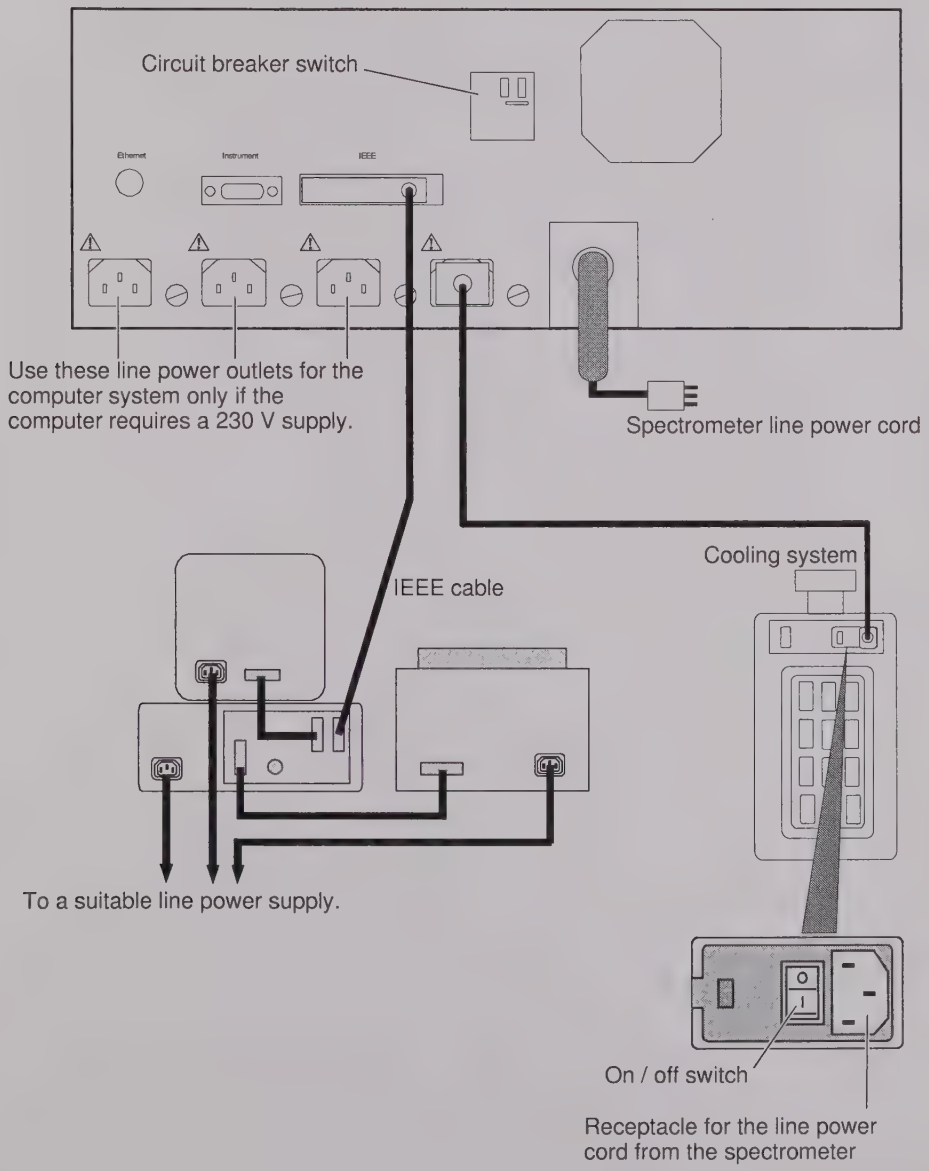
Warning: Electrical Hazard

- *To prevent potential injury to yourself and damage to the instrument, switch OFF all instruments in the system and disconnect them from the line power supply before you perform the procedures described below.*

Read the following instructions very carefully before connecting any cables.

See the *Laboratory Requirements* for the specification of the line power supply.

1. Make sure that the spectrometer and the cooling system are switched off.
2. Switch the circuit breaker on the rear panel of the spectrometer to the off position (marked O).
3. Switch off the computer and all other instruments that you will connect to the spectrometer or computer. See the guides for the individual instruments for the procedure to use.
4. Disconnect the line power cords of the spectrometer and all other instruments from the line power supply.
5. Connect the instrument control cables and power cords as shown on the following page.
   - Connect the line power socket on the cooling system to the correct power outlet on the rear of the spectrometer. Use the cable provided with the cooling system.
   - If the computer and printer require 230 V, connect them to the correct power outlets on the rear of the spectrometer that are provided for this purpose.
   - To avoid problems of interference caused by earth loops, always connect the computer, printer and any accessories to the same phase and protective earth (ground) of the line power supply.
   - Use the IEEE cable provided. Secure the IEEE connectors to the instruments with the screws on the connectors.
6. When you have completed all connections, switch on the system as described in the *Setting Up and Performing Analyses* guide.


Circuit breaker switch
Ethernet
Instrument
IEEE
Use these line power outlets for the computer system only if the computer requires a 230 V supply.
Spectrometer line power cord
Cooling system
IEEE cable
To a suitable line power supply.
On / off switch
Receptacle for the line power cord from the spectrometer

Laboratory Requirements

3

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Electrical requirements	3-7
Fume ventilation	3-8
Gas supply requirements	3-8
Lamps	3-10
Computer and printer	3-10

Summary

The SIMAA 6000 spectrometer has some special requirements that you must consider when setting up the laboratory. The laboratory must fulfil these requirements, described in this chapter, and summarized below, before you can operate the spectrometer correctly.

W1.3

Warning: Explosive Atmosphere

This instrument is not designed for operation in an explosive atmosphere.

- Indoors.
- Free of dust, smoke and corrosive fumes.
- Temperature between +15 °C and +35 °C (+59 °F to +95 °F).
- Humidity between 20% and 80% relative humidity (non-condensing).
- Out of direct sunlight.
- Away from radiators and heaters.
- The work surface must be level, flat, clean, dry, and free from vibration. It should be strong and stiff enough to bear the weight of the spectrometer system over a long period without warping or bending. A movable table is very convenient, but make sure that the wheels can be securely locked.
- Have sufficient room to work comfortably with the instruments, and allow you to reach the controls and connections easily — see *page 3-4*.
- Suitable electricity and gas supplies — see *page 3-7* and *page 3-8*.
- Have a suitable fume ventilation system — see *page 3-8*.

Brochure no. L-301 – *Preparing Your Laboratory for Perkin-Elmer Atomic Spectroscopy Instruments* – also contains useful information. This brochure is available from Perkin-Elmer.

Space requirements for the spectrometer system

The illustrations on the following pages show the dimensions of the spectrometer and the space that you require to accommodate the spectrometer, computer, and ancillary equipment.

- You should have sufficient room around the instruments to reach the isolator switch on the rear and all the connectors for gas, water and electricity.
- The laboratory ventilation system needs space above the spectrometer.

Cooling system

Place this on the floor near the spectrometer. Make sure that you can see the water level indicator.

The cooling system also includes a pressure-sensitive safety switch. If the pressure in the circulatory system increases to above 650 kPa (6.5 bar, 95 psig) the cooling system pump is switched off automatically. This feature eliminates the risk of damage to the graphite furnace through excess pressure. A pressure increase could be caused, for example, if one of the hoses is kinked. You must only use the cooling system supplied to cool the SIMAA 6000 spectrometer.

Computer and printer

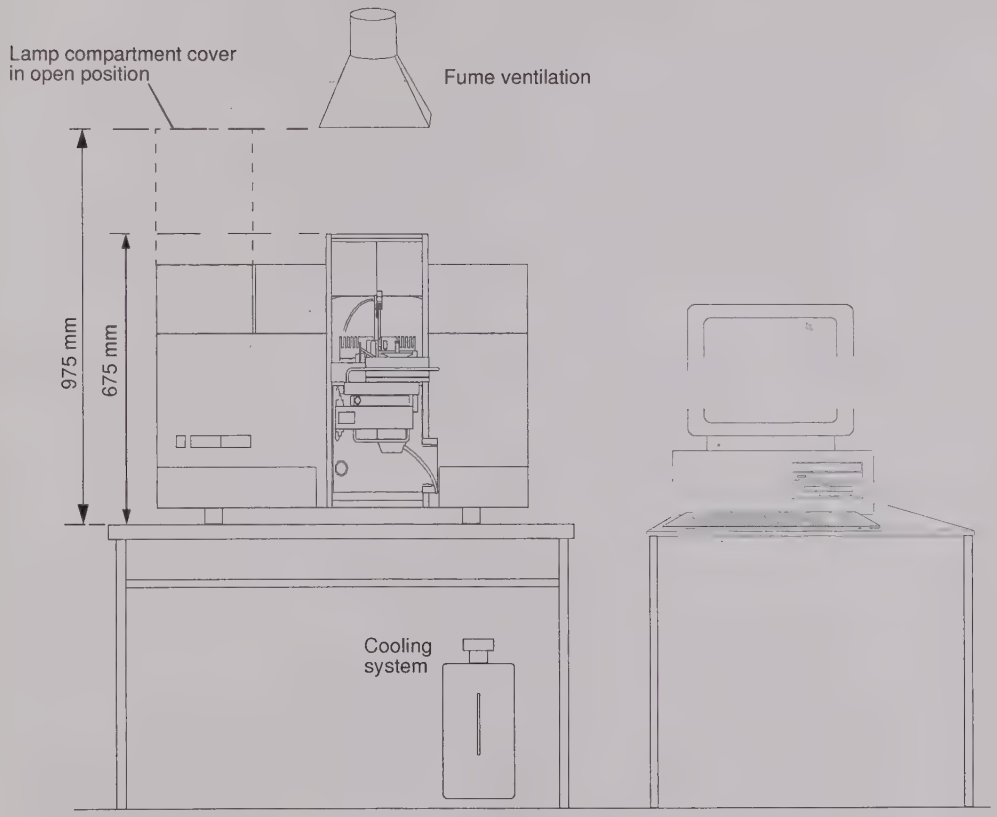
Place the computer near the spectrometer in a convenient position for working with both instruments. A movable table, specially designed for a computer and printer, may be most convenient.

Accessories

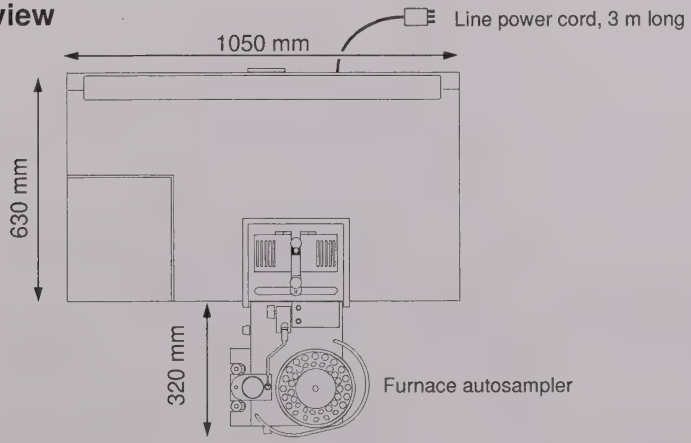
Make sure that there is sufficient room for any accessories near to the spectrometer.

Zeeman graphite furnace systems

The electromagnet generates a strong magnetic field inside the THGA furnace during measurement cycles.
There is a weak, accessible, stray magnetic field around the graphite furnace. This stray magnetic field can affect heart pacemakers and metallic implants up to 0.6 meter from the furnace in all directions. This stray field can also affect other instruments, watches, and magnetic storage devices, *illustration, page 3-6*


Lamp compartment cover
in open position
Fume ventilation
975 mm
675 mm
Cooling
system

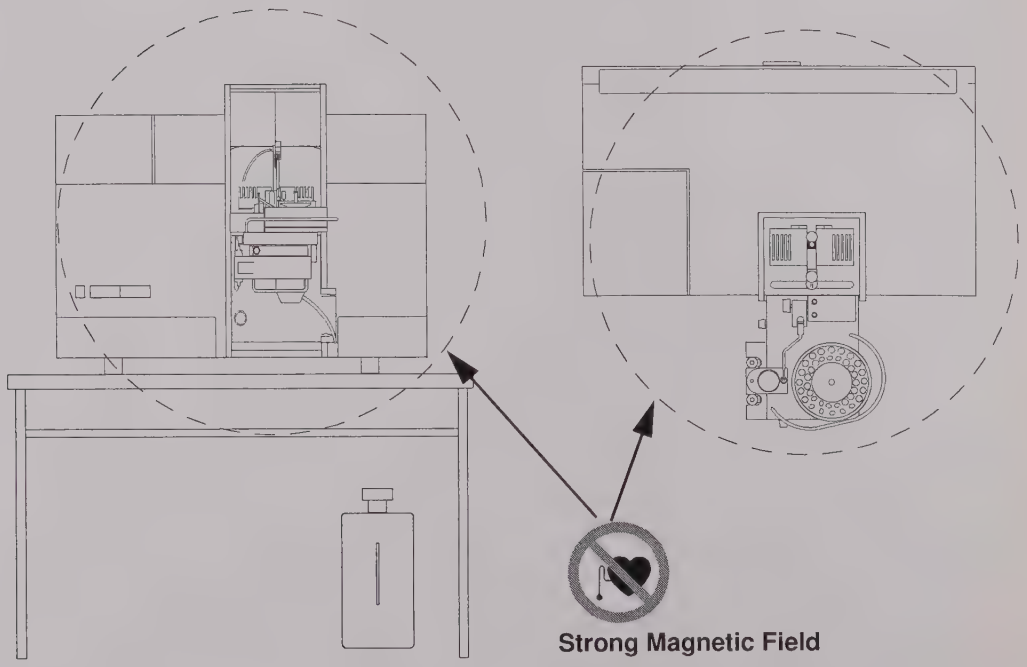
Top view


Line power cord, 3 m long
1050 mm
630 mm
320 mm
Furnace autosampler

Magnetic field

The electromagnet generates a strong magnetic field inside the THGA furnace during measurement cycles.
There is a weak, accessible, stray magnetic field around the graphite furnace. This stray magnetic field can affect heart pacemakers and metallic implants up to 0.6 meter from the furnace in all directions. This stray field can also affect other instruments, watches, and magnetic storage devices.

- Do not operate the furnace when persons wearing electronic heart pacemakers, or having other metallic implants, are present.
- Anyone wearing a heart pacemaker or having metallic implants should remain at least 0.6 meter away from the furnace – in any direction – while the furnace is operating.



Strong Magnetic Field

Safety distance of 0.6 meter (24 inches) radius around the furnace magnet for persons wearing heart pacemakers

Electrical requirements

240 V, 60 Hz instruments

- The line power supply point must have a L6-30R, NEMA-configuration twistlock receptacle (3 wire – line, neutral, grounding), rated for 240 V/30 A.
- Each spectrometer installation requires a separate 5-wire electrical line with a wire cross-section of 4 mm^2.

3~230 V, 50 Hz (3-phase, 400 V) instruments

- The line power supply point must have a 5-pole CENELEC receptacle (3 phases + neutral + protective earth), rated for 32 A.
- Each spectrometer installation requires a separate 5-wire electrical line with a wire cross-section of 4 mm^2.

General requirements

- The spectrometer requires a stable, 50 Hz or 60 Hz line power supply at the correct voltage and current rating that has a correctly wired protective earthing system (ground connection). The line power supply must conform with local safety regulations and be checked by a qualified electrician before you connect the instrument to line power.
- The line power supply should be free of line transients in excess of 50 V peak. If the electrical supply voltage produces large AC line voltage fluctuations, a qualified electrician should install a voltage regulator between the electrical outlet and the instrument.
- Power consumption during furnace operation is approximately 5000 VA, at an isothermal furnace temperature of 2600 °C.
- The line power supply point must be within 3 meters of the rear of the spectrometer.
- We recommend that you connect the spectrometer, computer, printer, and any accessories to the same phase of the line power supply and the same protective earth.
- See the guides for the computer and printer and any other instruments for information about their power requirements.

Fume ventilation

You must provide an efficient fume ventilation system to remove the fumes generated by the atomizer (flame, graphite furnace, or the QTA-cell of FIAS systems).
The specification for a suitable system is described in brochure no. L-301 – *Preparing Your Laboratory for Perkin-Elmer Atomic Spectroscopy Instruments.*
This brochure is available from Perkin-Elmer.

Warning: Toxic Gases – Fume Ventilation System

Without adequate ventilation, potentially toxic vapors can build up in the laboratory.

- *Your laboratory must have a reliable fume ventilation system before you use this instrument.*

Gas supply requirements

The permanent installation of gas supplies is the responsibility of the user and should conform to local safety and building regulations.
Perkin-Elmer recommends that cylinders be stored outside the laboratory and that gases be piped to the spectrometer system in approved gas lines.

- The user must provide the gas supplies, regulators, connectors, and valves. Either the gas supplier or Perkin-Elmer can supply the correct regulators and valves.
- You must be able to reach the on/off valves easily and see the pressure indicators.
- Consult the chapter entitled *'Safety Information'* for recommended safety procedures.

Warning: Compressed Gases

High pressure gas cylinders can be dangerous if mishandled or misused.

- *Always handle gas cylinders with caution and observe you local regulations for the safe handling of gas cylinders.*

Furnace gases

Inert gas

The graphite furnace requires a supply of inert gas to prevent the tube and the analyte atoms from being oxidized when the tube is heated.
Argon is the recommended inert gas.
If you cannot obtain argon, you can use purified nitrogen, but nitrogen does not provide such efficient protection as argon at temperatures above 2000 °C. Nitrogen can also react with the samples and the graphite tube at typical atomization temperatures.

W6.1

Warning: Toxic Gases

If you use nitrogen as the inert gas, toxic cyanogen gas $(CN)_2$ *will be produced when the furnace temperature is above 2300 °C.*

- *Make sure that the main laboratory fume ventilation system removes all gases and fumes emitted by the furnace.*

Special gas

For some applications you may want to use a special gas. A typical example is the use of air during one of the pyrolysis steps to better ash organic materials.

Gas	Purity	Outlet Gauge Pressure						Max. flow-rate
		kPa		bar		psig		L/min
		P	P_{max}	P	P_{max}	P	P_{max}	1.2
Argon	99.996%	350	400	3.5	4.0	50.0	58.0	1.2
Nitrogen	99.996%	350	400	3.5	4.0	50.0	58.0	1.2
Special	particle free; water free	350	400	3.5	4.0	50.0	58.0	1.2

- Set the outlet gauge pressure to the recommended value (P) for each gas.
- **Never** set the outlet pressure to a value exceeding the maximum pressure (P_{max}).

Lamps

These are often called primary source lamps, atomic absorption source lamps, spectroscopic lamps, or line sources.

You need to provide the lamps for your particular applications.
The Perkin-Elmer supplies catalog contains descriptions of all the lamps that are available.

Computer and printer

Perkin-Elmer offers a suitable computer for controlling the spectrometer and a suitable printer. Contact your local Perkin-Elmer office for more information.
If you are not using the computer offered with the spectrometer by Perkin-Elmer, or an identical model with the correct specification, Perkin-Elmer cannot accept responsibility for incorrect functioning of the spectrometer system.

Parts Provided

4

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Perkin-Elmer reserves the right to alter the schedule of parts provided without prior notice.

Spectrometer and furnace

Qty.	Item	Part No.
1	SIMAA 6000 atomic absorption spectrometer *(version according to order)*	
1	AS-72 furnace autosampler, see *page 4-4*	
1	Cooling system	
3	Special line cords	B310-0003
1 pack	Replacement fuses	B310-0203
1 pack	Replacement air filters	B050-2706
4	Plugs, for handle screw holes	B015-3803
1	Hose kit	B311-0036
10 m	Special gas tube (FLEXO)	B050-8264
1	Y-connector	0992-0179
1 pack	Graphite tubes	B300-0409
1 set	Graphite contacts	B300-0410
1 pack	Cleaning swabs	B050-5368
1	Grips for graphite tube	0990-7925
1 set	Tools, for changing contacts and furnace windows	B312-0405
1	Instrument mirror	B085-1900
1	Replacement O-ring, for the pressure cylinder in the front contact housing and the optical sensor in the rear contact housing	B013-2870
1	Documentation package	

Furnace autosampler

Qty.	Item	Part No.
1	Furnace autosampler together with the following components	
1	Sample tray, 80 locations	B051-0404
1	Sample tray, 40 locations	B051-0417
1 pack	Sample cups, polypropylene, 1.2 mL, pack of 2000	B051-0397
1 pack	Sample cups, polystyrene, 2.0 mL, pack of 100	B051-0140
1	'Cloverleaf' container, polypropylene, 25 mL, for locations 76–80/36–40	B013-2799
5	Reagent containers, polystyrene, 26 mL, for location 0 in the overflow.	B010-2332
1	Rinsing port, long, with notch	B012-9089
1	Rinsing port, short	B012-9088
2	Rinse and waste bottles, polyethylene, 2 L	B010-4344
1	Drain tube	B010-4988
1	Rinse feed assembly:	
	Rigid tube	B300-1363
	Flexible tube	B001-7998
	Front ferrule, 2.45 mm	B300-1333
	Back ferrule, 2.45 mm	B300-1334
	Nut	B300-1335
1	Grips for 1.2 mL sample cups	B051-0398
1	Wrench for the pump head retaining ring	B300-1365

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Customer Service

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Phone: (800) 762-4000 or
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Fax: (203) 762-6000

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Verkauf und Service
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Supplies, replacement parts, and accessories

Supplies, replacement parts, and accessories can be ordered directly from Perkin-Elmer, using the part numbers quoted in the handbooks provided with the instrument.

Perkin-Elmer's catalog service offers a full selection of high-quality supplies.

To place an order for supplies and many replacement parts, request a free catalog, or ask for information:

- If you are located *within the U.S.*, call toll free **1-800-762-4002**, 8 a.m. to 8 p.m. EST. Your order will be shipped promptly, usually within 24 hours.
- If you are located *outside of the U.S.*, call your local Perkin-Elmer sales or service office.

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PERKIN ELMER

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